CLAIMS

What is claimed is:

1. A pool controller system for distributing line voltage from a line voltage service to one or more line voltage loads and controlling operation of a pool service system, comprising:

a housing;

a controller circuit board assembly mounted within the housing, including a plurality of line voltage output terminals for connection to respective line voltage loads via line voltage wiring connections, a set of circuit board line voltage contact surfaces, a plurality of circuit conductors for providing circuit connections between the contact surfaces and respective ones of the line voltage output terminals, wherein the controller circuit board assembly routes line voltage from the circuit board line voltage contact surfaces to the output terminals;

a terminal connector structure mounted within the housing, said connector structure having a set of line voltage connectors, each line voltage connector including a pressure connector for pressure connection of a corresponding set of line voltage service conductors and a connector line voltage contact surface for contacting a board line voltage contact surface;

removable fastening structures for securing the board assembly in position within the housing such that each of the circuit board line voltage contact surfaces is in intimate electrical contact with a corresponding connector line voltage contact surfaces, and for permitting the board assembly to be removed for repair or replacement without disconnecting the line voltage supply conductors from said pressure connectors.

2. The system of Claim 1 further including:

a plurality of sets of line voltage conductors for connections from the circuit board assembly to the respective plurality of line voltage loads; and

at least one line voltage connector structure for removable connection of the plurality of sets of line voltage conductors to corresponding ones of the line voltage output terminals, wherein the sets of line voltage conductors can be readily connected and disconnected from the board assembly by use of the connector structure.

3. The system of Claim 1 further comprising a voltage transformer for transforming the line voltage to low voltage levels, and wherein the board assembly includes:

a plurality of low voltage terminals for connection to low voltage wiring running to low voltage devices;

at least one low voltage connector structure for removable connection of said low voltage wiring, wherein the low voltage wiring can be readily connected and disconnected from the board assembly by use of the low voltage connector structure.

4. The system of Claim 1 wherein the board assembly further includes a plurality of non-resettable circuit protection devices for providing circuit protection for the line voltage loads.

5. The controller system of Claim 4, wherein the circuit protection devices include fuse devices mounted on the printed wiring board.

6. The controller system of Claim 1, wherein the circuit board assembly includes a prefabricated printed wiring board including conductor traces, and the plurality

of circuit conductors are defined by a set of said circuit traces.

7. The controller system of Claim 1, wherein said line voltage supply is a line voltage supply having a neutral conductor, a first phase conductor and a second phase conductor, and the first phase conductor and the second phase conductor are connected by a corresponding one of said pressure connectors.

8. The controller system of Claim 1, further comprising:

a voltage transformer mounted within the cabinet housing for transforming line voltage to low voltage; and

wherein the controller circuit board assembly further includes a plurality of low voltage switches for selectively applying low voltage to respective low voltage output wiring connections.

9. The controller system of Claim 1, wherein the cabinet housing defines a main compartment and a plurality of secondary compartments, the main compartment having routed therein all line voltage wiring entering the cabinet, the secondary compartments being shielded from the main compartment and having routed therein only low voltage wiring carrying low voltage signals.

10. The controller system of Claim 9, wherein the main compartment is separated from the plurality of secondary compartments by conductive inner wall structures.

11. A method for installing a pool controller system in a pool service system including one or more line voltage loads, comprising:

providing a pool controller circuit board assembly, the assembly including a plurality of line voltage output terminals for connection to respective line voltage loads via line voltage wiring connections, a set of circuit board line voltage contact surfaces, a plurality of circuit conductors for providing circuit connections between the contact surfaces and respective ones of the line voltage output terminals, wherein the controller circuit board assembly routes line voltage from the circuit board line voltage contact surfaces to the output terminals;

providing a terminal connector structure, said connector structure having a set of line voltage connectors, each line voltage connector including a pressure connector for pressure connection of a corresponding set of line voltage service conductors and a connector line voltage contact surface for contacting a board line voltage contact surface;

mounting the terminal connector structure within a housing;

connecting the set of line voltage service conductors to the terminal connector structure with the pressure connectors;

securing the board assembly in position within the housing with removable fastening structures such that each of the circuit board line voltage contact surfaces is in intimate electrical contact with a corresponding connector line voltage contact surfaces.

12. The method of Claim 11 further including:

providing a plurality of sets of line voltage conductors for connections from the circuit board assembly to the respective plurality of line voltage loads;

connecting the plurality of sets of line voltage conductors to corresponding ones of the line voltage output

terminals by at least one line voltage connector structure, wherein the sets of line voltage conductors can be readily disconnected from the board assembly by use of the connector structure.

13. The method of Claim 11 wherein the board assembly includes a plurality of low voltage terminals for connection to low voltage wiring running to low voltage devices, the method further comprising:

connecting the low voltage terminals to the low voltage wiring using at least one low voltage connector structure for removable connection of said low voltage wiring, wherein the low voltage wiring can be readily connected and disconnected from the board assembly by use of the low voltage connector structure.

14. A pool controller system for distributing line voltage from a line voltage service to one or more line voltage loads and controlling operation of a pool service system, comprising:

a housing, comprising a main compartment and a plurality of secondary compartments;

a controller circuit board assembly mounted within the main compartment of the housing, including an electronic controller, a plurality of line voltage output terminals for connection to respective line voltage loads via line voltage wiring connections, a plurality of low voltage terminals for connection to respective low voltage devices, a set of circuit board line voltage contact surfaces, a plurality of circuit conductors for providing circuit connections between the contact surfaces and respective ones of the line voltage output terminals, wherein the controller circuit board assembly routes line voltage from the circuit board line voltage contact surfaces to the

output terminals, and routes low voltage signals between low voltage circuitry on the circuit board, the controller and the low voltage terminals;

a plurality of line voltage supply conductors passed into the main compartment of the housing from a line voltage supply source;

a plurality of sets of line voltage load conductors passed into the main compartment of the housing from said plurality of line voltage loads and connected to the circuit board assembly;

a plurality of sets of low voltage conductors connected to respective low voltage devices, the sets of low voltage connected routed from respective ones of the secondary compartments into the main compartment for connection to the circuit board assembly;

wherein no conductors carrying line voltage are routed into any of the plurality of secondary compartments.

15. The system of Claim 14 wherein:

the line voltage supply is a 240 VAC line voltage supply;

at least one of said line voltage loads is a 240 VAC load; and

at least one of the line voltage loads is a 120 VAC load.

16. A method for providing line voltage to a plurality of line loads for a bathing pool installation, comprising:

connecting a line voltage supply at a line voltage distribution panel to a ground fault circuit interrupter (GCFI), the line voltage having a sufficient power rating to supply power for said plurality of loads;

providing a pool control panel including a pool controller circuit assembly, the assembly including a circuit protection device and an electrical switching device for each of said plurality of line voltage loads, a wiring circuit to distribute line voltage through the respective circuit protection devices and circuit protection devices to line voltage load terminal connections at the controller circuit assembly, and an electronic controller coupled to each of the switching devices for actuating each of said switching devices;

providing a GFCI-protected line voltage connection between the GFCI and the controller circuit assembly; and

electrically connecting each of said plurality of line voltage loads to a corresponding terminal connection at said controller circuit assembly.

17. The method of Claim 16 wherein the circuit protection devices include fuse protection devices.

18. The method of Claim 16 wherein the switching devices include switching relays.

19. The method of Claim 16 wherein:

the line voltage supply is a 240 VAC line voltage supply;

at least one of said line voltage loads is a 240 VAC load; and

at least one of the line voltage loads is a 120 VAC load.

20. In a bathing or swimming pool installation, including a pool water holding structure, a method for releasing water into the water holding structure, comprising:

providing a valve connected to a water supply line, the valve responsive to valve control signals to open and close, wherein the valve in an open state releases water from the water supply line into the water holding structure, and in a closed state prevents water from flowing from the water supply line into the water holding structure;

providing an electronic control system responsive to a user commands through a control panel to generate the valve control signals;

entering a user command through the control panel to actuate the valve;

opening the valve in response to the user command;

automatically closing the valve after a predetermined time has elapsed after opening the valve.

21. The method of Claim 20 further comprising:

setting the predetermined time during a programming mode.

22. The method of Claim 21 further comprising:

storing in an electronic memory a time value corresponding to the predetermined time.

23. The method of Claim 20 further comprising:

automatically closing the valve if the water level reaches an overfill level during the predetermined time interval.

24. In a bathing or swimming pool installation, including a pool water holding structure and a pool control system, a method for automatically releasing water into the water holding structure, comprising:

providing an electronic pool control system capable of monitoring water parameters including water temperature, the pool control system responsive to a water level sensor signal;

providing a valve connected to a water supply line, the valve responsive to valve control signals to open and close, wherein the valve in an open state releases water from the water supply line into the water holding structure, and in a closed state prevents water from flowing from the water supply line into the water holding structure;

sensing the level of water in the water holding structure and generating the water level sensor signal when the water level reaches a predetermined water level;

opening the valve in response to the sensor signal;

subsequently closing the valve.

25. The method of Claim 24 wherein the valve is automatically closed after a predetermined time has elapsed since opening the valve.

26. The method of Claim 24 wherein the valve is closed in response to a further signal from the water level sensor.

27. A pool controller system for controlling operation of a pool service system including a water heater, a water filter, and for providing an automated water fill capability, comprising:

a valve connected to a water supply line, the valve responsive to valve control signals to open and close, wherein the valve in an open state releases water from the water supply line into the water holding structure, and in

a closed state prevents water from flowing from the water supply line into the water holding structure;

an electronic controller system responsive to manually entered user commands through a control panel to generate the valve control signals, the controller system for actuating the fill valve to the open state in response to a predetermined user fill command, and for automatically closing the valve upon elapsement of a predetermined fill time interval.

28. The system of Claim 27 wherein the controller is further responsive to user commands manually entered through a control panel for setting the fill time interval.

29. The system of Claim 27 further including:

a filter for filtering water recirculated in the spa or pool; and

pressure sensing apparatus for sensing a filter back-pressure and providing filter pressure signals; and

wherein the controller system is responsive to the filter pressure signals to provide a visual status signal indicating that the need for filter servicing in the event the filter backpressure exceeds a threshold.

30. A spa or pool control system with an emergency shutdown capability, comprising:

one or more electrically powered devices associated with operation of the spa or pool;

a controller system operatively connected to the one or more electrically powered devices for controlling the operation of said one or more devices;

a ground fault circuit interrupter (GFCI) circuit;

a line voltage service connected to the controller system through the GFCI circuit, the GFCI circuit adapted

to detect ground faults and interrupt the service upon detection of a ground fault;

a manually actuated low voltage emergency switch system mounted in the vicinity of the spa or pool, the switch system connected to the controller system and to a ground fault test circuit, the test circuit inducing a ground fault between line voltage and ground upon activation by the emergency switch system, thereby tripping the GFCI circuit.

31. The control system of Claim 30, wherein the controller system includes a monitoring system for detecting the presence of the emergency switch system and taking a predetermined action in the event the emergency switch system is not detected.

32. The control system of Claim 30 wherein the predetermined action includes interrupting line voltage to the devices.

33. The control system of Claim 30 wherein the predetermined action includes generating an audible or visual warning signal indicating that the emergency switch system has not been detected.

34. The control system of Claim 30 wherein the emergency switch system includes a normally open manually activated switch, and the monitoring system includes a resistive element connected in parallel with the switch, a circuit for providing a low voltage across the resistive element, and a voltage monitoring circuit for monitoring a voltage on the emergency switch system, wherein the control system is responsive to signals provided by the monitoring

system to determined whether the emergency switch system is properly installed.

35. A spa or pool system, comprising:

a gas-fired heater for heating water circulated into the spa or pool, the heater connected to a source of gas fuel through a gas input line;

a gas pressure sensor coupled to gas input line to detect the gas pressure level, the sensor providing a gas pressure sensor signal;

a controller system operatively connected to the heater for controlling the operation of the heater, the controller system responsive to the gas pressure sensor signal to take a predetermined action in the event the sensor signal indicates that the gas pressure is below a predetermined gas pressure threshold value.

36. The system of Claim 35, wherein the predetermined action includes generating an audible or visual warning signal.

37. The system of Claim 35 wherein the predetermined action includes disabling the heater from operation.

38. In a pool/spa service system including an electronic controller, the controller receiving electrical power from a line voltage powered circuit, and including a ground fault interrupt circuit (GFCI) for interrupting line voltage in the event of a detected ground fault, a method for checking for proper operation and installation of the GFCI, comprising:

inducing a ground fault between line voltage and ground to check operation of the GFCI;

monitoring line voltage to determine whether line voltage has been interrupted in response to the induced ground fault;

if interruption of line voltage does not occur, automatically taking a predetermined warning or corrective action.

39. The method of Claim 38 further including generating a warning signal indicative of failure of the GFCI if interruption of line voltage does not occur in response to said inducing of said ground fault.

40. The method of Claim 38 further including the step of storing test outcome indicating data in a nonvolatile memory in the event interruption of line voltage occurred in response to said inducing a ground fault, said stored data indicating successful completion of the GFCI test, said storing occurring prior to shutting down operation of the controller due to said interruption of line voltage.

41. The method of Claim 40, further comprising:

powering up the controller;

reading said nonvolatile memory to determine whether said test outcome indicating data is stored in said memory;

if said test outcome indicating data is stored in memory, operating the controller in a normal manner.

42. The method of Claim 38 wherein said step of inducing a ground fault includes closing a controller controlled switch to connect a resistive element from a line voltage conductor to earth ground.

43. The method of Claim 38 wherein said step of monitoring line voltage includes converting the line

voltage to a low voltage waveform of similar periodicity as the line voltage, and monitoring the low voltage waveform to detect that the waveform has been interrupted.

44. The method of Claim 38 wherein said taking said predetermined warning or corrective action includes:

providing a warning signal indicating that the GFCI is not properly connected or operational.

45. The method of Claim 38 wherein said taking said predetermined warning or corrective action includes preventing the system from operating normally.

46. The method of Claim 45 wherein said system includes at least one line voltage load controlled by the controller, and said preventing said system from operating normally includes preventing application of line voltage to the at least one line voltage load.

47. The method of Claim 38 wherein said method is an algorithm automatically performed by the controller.

48. A method for operating an electronic pool/spa controller which has control of at least one line voltage load, and wherein the line voltage which powers the load also provides primary power for the electronic controller and is protected by a ground fault circuit interrupter (GFCI), the method comprising:

applying electrical power to the controller, the electrical power resulting from the line voltage;

checking a nonvolatile memory for information regarding prior successful GFCI testing;

if said information is stored in said memory, proceeding to normal controller operation;

if said information is not stored in said memory, conducting a GFCI test procedure, said procedure including inducing a ground fault, determining whether line voltage is interrupted within a predetermined time period after said inducing, if line voltage is interrupted, continuing operation of the controller through a short term auxiliary power supply in order to write to said nonvolatile electronic memory said information.

49. An improved reliability temperature sensor, comprising:

a housing;

a first solid state temperature sensing device mounted in the housing;

a second solid state temperature sensing device mounted in the housing;

a first conductor circuit for making electrical connection from outside the housing to a first terminal of said first device and to a first terminal of the second device;

a second conductor circuit for making electrical connection outside the housing to a second terminal of the first device; and

a third conductor circuit for making electrical connection outside the housing to a second terminal of the second device.

49. The sensor of Claim 48 wherein said first device is a first thermistor, and said second device is a second thermistor.

50. The sensor of Claim 48 further comprising a circuit board assembly for mounting said first thermistor device and said second thermistor device, said circuit

board assembly being inserted into said housing during assembly, and a collar structure which includes a stop shoulder surface which contacts an end of said housing to control a depth of insertion of said circuit board assembly into said housing.

51. The sensor of Claim 50 wherein said first and second solid state temperature sensing devices are mounted adjacent a distal end of said circuit board assembly a predetermined distance from said distal end when said stop shoulder surface contacts said housing end.

52. The sensor of Claim 50 further comprising a potting compound disposed in said housing.

53. A method of assembling and programming a circuit board assembly for a bathing pool controller system, comprising:

providing a circuit board configured for in-circuit-programming;

populating the board with electronic circuit devices;

installing an in-circuit-programmable microprocessor device on the circuit board;

connecting the board to a programmer device using electrical connections;

loading a program into a nonvolatile memory of the microprocessor device from the programmer device;

powering up the circuit board; and

verifying the proper functioning of the circuit board with the microcomputer.